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W A S H I N G T O N, D.C.

A
DISSERTATION
ON THE
MINERAL WATERS
OF
SARATOGA;
CONTAINING,

A TOPOGRAPHICAL DESCRIPTION OF THE COUNTRY, AND THE
SITUATION OF THE SEVERAL SPRINGS; AN ANALYSIS OF
THE WATERS, AS MADE UPON THE SPOT, TOGETHER
WITH REMARKS ON THEIR USE IN MEDICINE,
AND A CONJECTURE RESPECTING THEIR
NATURAL MODE OF FORMATION:

A L S O,

A METHOD OF MAKING AN ARTIFICIAL MIN-
ERAL WATER, RESEMBLING THAT OF SA-
RATOGA, BOTH IN SENSIBLE QUAL-
ITIES AND IN MEDICINAL VIRTUE.

By VALENTINE SEAMAN, M. D.
Physician in the City of New-York.

“ In all ages, good Physicians, desirous of establishing
the salutary art, on a firm foundation, have considered it
incumbent on them, to submit to chemical analysis, such
Waters as were famous for the cure of any Disease.”

BERGMAN.

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T O

ROBERT R. LIVINGSTON,

CHANCELLOR OF THE

State of NEW-YORK, PRESIDENT of the SOCIETY,
instituted in the State of NEW-YORK, for the
promotion of AGRICULTURE, ARTS,
MANUFACTURES, &c.

NOTHING less than a belief of the indulgent disposition so notedly predominant in great minds, could have prevailed with me to submit the following dissertation to thy perusal, which I was the more desirous of doing, from the benevolent manner in which thou hast employed thy great talents, in the promotion of useful knowledge—pointing thee out as the proper Patron of an attempt, whose object is the general good, and which, from its being the first production of the kind, that has yet appeared in the state, if it cannot more justly claim, at least is in the more need of protection.

WITH a desire that thy labours may continue to merit the thanks of thy countrymen, and that thou mayest increase in utility, as thou advancest in years ;

I remain, with due respect,
and esteem—

thy friend,
VALENTINE SEAMAN,

1st. Mo. 1st, 1793.

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INTRODUCTION.

IT is justly expected of every physician, that at least, he will enquire into the virtues of such substances, as shall offer themselves to his observation, supposed to possess active medicinal qualities: for “The Lord hath created medicines out of the earth; and he that is wise will not abhor them*”. And as there still remain diseases, which dare raise up their reproachful heads, in obstinate defiance of our art, it is more especially our duty to search out weapons for their destruction: for it is not consistent with our ideas of the goodness of the Deity, to suppose that he would have permitted the favourites of his creation to be inflicted with diseases, without having formed remedies for their relief: but for these, as for relief from spiritual evils—*we must seek, and we shall find*; and as in the latter case, we are directed to the almighty “Father of spirits;” so in the former we should apply to the supplier of all corporeal wants—our all bountiful mother earth, out of whose bosom, as above observed, “The Lord hath created medicines.”

AMERICAN physicians, in particular, from their being situated in a country, with respect to medical researches, almost unexplored, must consider it doubly incumbent on them, to attend to its productions; for besides the ipecacuanha, the snake-root, the jalap, and many other useful re-

medies;

* Ecclesiasticus xxxviii. 4.

medics; America has also already furnished a bark, that has removed the fatality of that disease, which in less than forty years deprived Britain of two of its monarchs* : and “ Who knows but what at the foot of the Allegany mountain there blooms a flower, that is an infallible cure for the epilepsy? Perhaps on the Monongahela, or the Potowmack, there may grow a root, that shall supply, by its tonic power, the invigorating effects of the savage or military life, in the cure of consumptions† :” and why may there not spring up a water, in some neglected valley, whose solvent quality, may melt down the torturing stone, or whose penetrating influence may root out the scrophula from the system?

WHAT funds of useful knowledge may there still be reserved for the discovery of Americans; since it was for them to check the fatal career of the cynanche maligna‡, and also to loosen the fixed jaw, and relax the rigid muscles of a tetanus*?

* The intermittent fever, which is now considered as an innocent complaint, was arranged in the class of incurable diseases, till the discovery of the Peruvian bark: James the 1st, and Oliver Cromwell, both died of this complaint.

† Dr. Rush's concluding lecture.

‡ The late Dr. Ogden, of Jamaica, Long-Island, was the person who first introduced the use of Calomel, in this complaint; before which, its fatality among children, was unparalleled, by any disease to which they are liable.

nus* ? Why may we not hope, that some other of our countrymen, may be fortunate enough, still farther to diminish the list of those diseases, which yet continue to elude the power of medicine ?

THESE reflections prevailed upon me, notwithstanding a surrounding cloud of difficulties†, to attempt to ascertain the composition of the mineral waters of Saratoga---whether I have fully succeeded or not, my experiments, (which I have inserted at full length, for that purpose,) with the skilful chemist will determine ; In the mean time, not doubting but that his knowledge of the intricacy of the subject will furnish him with a cover for the little inaccuracies he may detect, particularly when he considers, that in this work, I have acted in the dangerous and toilsome capacity of a pioneer, I have opened a way to the analysis of these waters, whereby others may follow on, probably with more success, at least with less difficulty‡.

IT

* We are indebted to Dr. Rush, for erasing this from the list of incurable diseases.

† The most able professions in Europe, say, that "The analysis of mineral waters, is justly considered, one of the most difficult problems in chemistry."

‡ No one has heretofore attempted to analyse these waters, all that has been done, was merely skimming their surface ; just an enquiry into the nature of the air discharged from them ; see Dr. Mitchell's experiments, related in the American Museum, Vol. IV. I am the first who has ventured to search into their real substance, to ascertain the ingredients of their composition.

It has been my intention to render this treatise as generally useful as possible; I have, therefore, not only forborn the use of the new and accurate nomenclature of the French chemists; but have also, in other respects, employed as familiar terms as the nature of the subject would admit of; and as in compositions of this kind, beauty of stile is less aimed at, than perspicuity of expression—I doubt not but that the reader will excuse me, if he finds some sentences which might have been expressed in more elegant language.

WHETHER water of itself considered, is a simple elementary substance, according to the opinion of the ancients, or a compound, as asserted by many of the moderns, though, perhaps, well deserving of attention, is not the business of this dissertation to determine? Its views being confined, merely to discover the nature of such mineral substances, as are often dissolved in it, and to which many waters owe their particular medicinal virtues.

SUCH mineral waters have been noticed as far back as the time of *Hippocrates*. *Pliny* mentions certain of them, as possessing medicinal properties; but we do not find any account of a method to detect their composition, till about the middle of the seventeenth century, when *Boyle* first observed, that the infusion of vegetable blues, was an accurate test for discovering the presence of uncombined acids or alkalies, by becoming red with the

the former, and green with the latter. He afterwards found out many other substances, for the more full examination of waters.

DURING the time that *Boyle* was employed in these researches, *Duclos* was busy in the analysis of the waters of France, and made several improvements, by the addition of galls, and the tincture of turnsol, to our stock of regents. *Hierne*, *Valerius*, *Boulduc* and many other celebrated chemists, continued to render this branch of science more perfect.

IN the beginning of the present century, *Hoffman*, followed by *Springsfield* and *Venel*, paid particular attention to what they called the mineral spirit of waters, and which since, by *Dr. Priestly*, has been proved to be the ærial or cretaceous acid.

THE mode of analising waters have been continually improving, since the first experiments of *Boyle*—till at length the celebrated *Bergman* has given the finishing stroke of its present perfection.

IN examining these waters, I have proceeded first by *reagents*, to ascertain the different ingredients in their composition: for notwithstanding a late author* considers these as mere amusing experiments, yet I rather suppose them very useful means, for that purpose, particularly when applied in the extensive manner that I have done; and I fancy every reader will be of my opinion,

B

upon

* *Rouelle*.

upon a candid perusal of this dissertation: I acknowledge we are thereby only enabled to discover the different ingredients of mineral waters—but not the proportion of each. I was, therefore, obliged to apply to *distillation*, to obtain the proportion of their aerial, and to *evaporation* and *chryſtalization*—that of their fixed principles.

A
DISSERTATION
ON THE
MINERAL WATERS
OF
SARATOGA, &c.



A topographical description of the country, and situation of the several springs.

THESE springs are situated on the westerly side of a valley, which lies about twelve miles west of the conflux of Fish-Creek, with the North River*, in the county of Saratoga, and state of New-York. This valley, at least the part of it where the springs rise, runs a northerly and southerly course, and appears to have been formed by a branch of the Kayadoroferes river; which flows through the middle of it. The high ground that forms the westerly bank of the valley, and which appears to supply the waters of these springs, which are situated at its foot, is composed, almost entirely, of calcarious rocks, whose

* Which is about two hundred miles above the city of New-York.

whose surface, however, is mostly overspread with a sand and clayey soil, and covered with tall pines and oaks: there are several deep subterraneous caverns observed in it, which open but a small distance from where the declivity commences. The bank on the easterly side appears almost entirely sand, with not the least vestige of calcareous earth, and is a perfect pine plane.

THE cause of this sudden change of soil, which however, is not peculiar to this place alone*, and also of the river's making its way, at this particular juncture—I leave to the speculation of the naturalist to determine, a mere knowledge of their existence and situation being all that is necessary, either as to their affording us an assistant means for ascertaining the nature of the mineral waters, in their neighbourhood, or as enabling us to account for the presence of ingredients we may find in them. About four miles west of these springs, I am informed there is a strong scented sulphurous spring.

THE springs are eight or ten in number, and all are within the space of about half a mile; the one which has particularly attracted the attention of the curious, and which is mostly drank by valetudinarians, rises about midway between the others; it is entirely surrounded by a rock of a conical shape, which is about five feet high,
and

* As Hempstead plains on Long-Island and its contiguous soil is a remarkable instance.

and whose base is about nine feet in diameter ; it has a circular hole, in its apex, of near ten inches across, which is the opening of its inner cavity in which the water rises to within about two feet of its top. This cavity, like the outside of the rock, enlarges, as it descends. The surface of this rock is of a brownish colour, and appears compact and polished, it has a check in one side of it, which is supposed to descend internally and form some vent below the surface of the ground, by which the water makes its way out, as it has not been known to overflow for several years past. The crack is believed to have been produced by the fall of a tree over the spring ; and the remains of the upper part of one which lies in the marsh below, and whose body is directed immediately towards it, renders this opinion very probable, since its size and situation prove that it must have stood on the opposite side of the rock ; indeed I am informed, by a man of that country, that he very well recollects when the tree stood there, and that then the water overflowed the rock : another person informed me, that he knew it to overflow in the time of the late war.

THESE waters naturally deposit a petrefactive matter where they flow ; thereby forming to themselves, a barrier of defence against the intrusion of heterogeneous substances : the reason why the *rock spring* (as the one just described is called) in particular has surrounded itself by such a regular

lar formed pyramidal mass—I take to be owing to its natural situation rendering it more inaccessible to the animals, that may have resorted here for the waters, (which they appear to be very fond of, as well as of licking substances about the springs, on account of their saline impregnation,) whence is has, perhaps, during the course of ages, been permitted, unmolestedly, to precipitate particles upon particles of its stony matter, till finally, it has attained its present appearance, while a spring, a small distance from it, which, (from its supplying the waters that are continually conveyed from it, by a little wooden gutter, fixed for that purpose, into the bathing tub; which is situated in a log inclosure, just below it in the marsh) is called the *bathing spring*; which, notwithstanding it has afforded a much greater quantity of this petrefactive deposition, so as to form an irregular rock, of about twenty one feet in diameter, around itself, by being more easily come at, has had its tender layers trodden down continually, as they formed, before they could assume any regular shape.

THE *stony matter* of these springs, by calcination, forms *quicklime*.

A PIECE of it, put into *vitriolic acid*, caused a great effervescence, and formed a *selenites*, or *plaster of Paris*, and also a small portion of *allum*, proved, by the solutions depositing a cloudy sediment, by passing *volatile alkaline gas* through it; and

and also *martial* vitriol, whence it assumed a beautiful *blue* colour, by the addition of *lime water* saturated with *Prussian blue* : hence the petrefactions must be composed of an *argillo calcarious earth* and *iron* ; to this last is owing the redish colour, with which great part of it is tinged.

HAVING settled these preliminaries ; I proceed more particularly to enquire into

THE NATURE OF THE WATERS.

First. Of their physical properties.

I. THESE waters, in general, appear nearly transparent, yet none of them are perfectly so, excepting that which rises up in a barrel, which the neighbours have fixed for the purpose of collecting it, and is called the *barrel spring* ; they are *colourless*, and emit a great quantity of *air* by agitation, even by standing still in an open vessel, it almost immediately forms bubbles around its inside, which soon rise up and are discharged. The vessel used to dip the water out of the rock, and also the bathing tub, soon gather an *ochery crust* upon their inner surfaces. Wherever these waters stagnate, around the springs, besides depositing the stony matter before mentioned, they also soon become covered with a *pellicle* of a metallic splendour, reflecting variegated colours.

II. THEY diffuse a *subtle penetrating odour*, which

which is most particularly experienced by breathing in the orifice of the rock.

III. WHEN drank, their first impression on the palate, is agreeably *acescent*, succeed by a nauseous saline taste ; they afterwards give up acescent eructations, like fermented liquors, and which are no ways unpleasant.

IV. THE hydrometer stands at the same height in these, as in snow water.

V. NOTWITHSTANDING the discharge of air from these waters, makes them appear to be in a continued ebullition, yet they are cold, the temperature, however, is not the same in all the springs ; but seems to diminish in proportion to their briskness, thus the bathing spring and the barrel, each of which discharges about twenty gallons in an hour, which is much more than the rest do, lowered Fatherinheits thermometre from 72° , the heat of the atmosphere, to 52° , while in the others it stood at 56° and 58° , but in the rock water, which runs very slowly, it remained at 67° .

VI. By the application of a gentle heat, these waters discharge a great quantity of *air* in bubbles ; it is upon this property, that their use in raising bread depends, and for which purpose they are carried away in considerable quantities, daily, even sometimes to eight or ten miles distance ; all that is necessary being merely to make the dough, with flour and this water alone, and it is immediately ready to put in the oven.

II. EX-

II. EXPERIMENTS UPON THE AIR.

I. A *lighted candle* let down in the crater of the rock, was immediately *extinguished*, both blaze and wick, before it came within a foot of the surface of the water: the air obtained by agitating the water of this, as well as of the other springs, was equally incapable of supporting combustion, as was also that collected from the bubbles, that were continually discharging from the different springs.

II. A *chicken* being immersed in this air, *expired* in three minutes. A *kitten* confined in it for one and a half minutes, appeared very flaccid and almost dead; yet, on being brought out, into free atmospheric air, its fleeting life was soon recalled through the medium of violent convulsions; being again put into the noxious gas, in fourteen minutes it was irrecoverably *dead*.

III. THE air being made to pass through *lime-water* immediately rendered it very *turbid*.

IV. It rendered a diluted *tincture of turnsol* of a *red tinge*, by passing through it.

FROM the physical qualities mentioned, and from the above experiments, we may safely conclude, that this air is the true *spiritus mineralis* of Hoffman, the *carbonic acid gas* of the French chemists, the *aerial acid* of Bergman, the fixed air of Priestly and Black, the *cretaceous acid* of Fourcroy,

croy, and what is generally known with the miners, by the name of *choak damp*; it is similar to the noxious gas, which rises up to the height of several inches, in the famous *grotto del cani* in Italy; this cave having received its name from its fatality to dogs: they, from carrying their heads below the surface of this stratum of air, being the animals which are generally submitted to experiment, to satisfy travellers of its deleterious effects. It is this air which is so plentifully given out, during the spirituous fermentation, and is what gives that briskness to porter, and other malt liquors. Being united with the vegetable alkali, it forms our common potash—hence the reason why our good housewives are enabled, any time, at half an hour's warning, to furnish us with a well raised cake, merely by mixing up the flour with a solution of potash and sour milk; here the acid of the milk, from a greater attraction, joins itself to the alkali, while the æriform acid being set at liberty, and assisted by the expansive power of heat, penetrates and puffs up every particle of the dough. It is this air also, which constitutes the difference between quicklime and chalk or limestone, its discharge is the effect of their calcination.

III. THE

III. THE EFFECTS OF REAGENTS UP- ON THE WATERS.

I. THE *rock water* had a little of the *tincture of turnsol* dropped into it, which immediately gave it a *reddish* tinge.

II. The infusion of our common blue lark-spur* was not changed by it.

III. In *lime-water*, it instantly induced a milky *turbidness*, followed by a *deposition of white powder*.

IV. *Tincture of galls* rendered it *purple*†.

V. *Prußian lime-water* produced no change in it.

VI. A *SOLUTION* of pure *vegetable alkali*, produced a *turbidness* in it.

VII. It was also made *turbid* by *aerated vegetable alkali*.

VIII. CAUSTIC

* The infusion of blue lark-spur, I have found to be a most accurate test for discovering the presence of the smallest quantity, of either uncombined alkalies, or fixed acids.

† It has been observed, that notwithstanding this water mixes with gin, without discoloration; yet it will not make grog: for immediately upon pouring in the spirits, it becomes blackish. This, though unaccountable to many, is no more than what every chemist would expect, when he considers that from the oak casks in which spirits is kept, it generally becomes a true *tincture*, of a vegetable astringent.

VIII. *Caustic volatile alkali*, forms a cloudiness in it ; yielding a *white precipitate*.

IX. *Vitriolic acid*, dropped into the water, caused a great effervescence, and a little *turbidness*.

X. AFTER vitriolic acid had been dropped in the water, it then became *blue* by *Prussian lime-water**.

XI. *Nitrated silver* formed an immediate copious *white curdled precipitate* ; this, as also the water itself, soon assumed a *dirty bluish colour*.

XII. *Nitrated mercury* produced a copious *yellowish precipitate*.

XIII. *Acid of sugar*, occasions a *cloudiness*, which soon falls down in a *white precipitate*.

XIV. *Acetated lead*, produced a copious *white*, but not *granulated precipitate*.

Most of these experiments were frequently repeated, and with similar results.

THE waters of the *other springs* exhibited the same appearances, with the above reagents, as the rock water, excepting that of the *bathing spring* and of the *barrel's* shewing a *deeper purple tinge with tincture of galls*.

THE water being *boiled*, discharged a great quantity of *air*, formed a *pellicle* on its surface, and deposited a *white powder*. It afterwards had

* This experiment, which is an original one, shews by what method we may detect *oxated iron*, by the *Prussian lime-water*, and tends to confirm the experiment with *tinct. of galls*.

had not that brisk acidulous taste, as before, but was extremely *nauseous*; it was not reddened by tincture of *turnsol*, nor rendered purple by tincture of *galls*; with infusion of *lark-spur*, it became green: it still precipitated lime-water, though not so plentifully as before, and also effervesced slightly, with vitriolic acid; but was not made turbid thereby. Acid of sugar did not induce a turbidness, its appearance was not altered by the caustic vegetable nor volatile alkalies, nor by the aerated vegetable alkali.

FROM these experiments, I conclude, that these waters contain,

I. *An uncombined ACID*, whereby they become red by tincture of *turnsol*, and that this cannot be a fixed acid, since it does not redden infusion of *lark-spur*, and is evaporated by boiling; for afterwards the water does not change tincture of *turnsol*; therefore it must be the *cretaceous acid*, the same as has been heretofore proved to be continually discharging from them, in large quantities: it is from the presence of this, that lime-water becomes so very turbid; for with lime it forms an insoluble compound.

II. IRON.—Hence it takes a purple tinge, with tincture of *galls*, and also, when previously joined with vitriolic acid, becomes blue, with Prussian lime-water, and that the iron is not kept in solution, by the vitriolic acid, or it would have become

become blue by this test, before the acid was united with it; but by the cretaceous acid, since after being boiled, this water is no more discoloured, by tincture of galls.

III. A QUANTITY of LIME held in solution by the cretaceous acid; for notwithstanding lime, as above observed, is rendered insoluble by uniting with the cretaceous acid, yet it is otherwise when supersaturated therewith; for then it is, to the contrary, much more soluble: hence the cause of a precipitation, by the caustic vegetable, and volatile alkalies. They, from their affinity to the acid, deprive the lime of its superabundance, and permit it to fall down in a white powder. The vitriolic acid, on the contrary, attracts the lime, and forms a gypseous deposition, while the cretaceous acid flies off in a great effervescence. The acid of sugar, also, evinces the presence of lime, by uniting and forming an insoluble compound with it. These tests did not exhibit the same appearances with the water, after ebullition: hence the pellicle and deposition formed, during that process, I take to be calcarious earth and iron.

IV. A MURIATIC ACID. Hence with nitrated silver it forms a sudden, caseous precipitate, and also a precipitate with nitrated mercury; this last precipitate on being sublimed, afforded corrosive sublimate.

V. A NEUTRAL SALT. Since they have been

been proved by the two last mentioned experiments, to contain a marine acid, and by some of the previous ones, that this cannot exist in a separate state; therefore it must be united either with an earth, or an alkali, and as a cretaceous alkali will be shewn to be present in the water, it is evident that it must be joined with the latter; since alkalies have a greater attraction for acids, than earths have.

VII. A CRETACIOUS ALKALI, whereby, after the water has been boiled, it renders the infusion of lark-spur green, and effervesces with vitriolic acid; this may also be the cause why lime-water is still precipitated by it. Here the cretaceous acid quits the alkali, to unite with its more attracting lime, forming therewith, as abovementioned, an insoluble compound. The reason why the water did not change the infusion of lark-spur, before it had been boiled, must be owing to the alkali's being supersaturated with the cretaceous acid, in which case, as I proved by an experiment made for that purpose, it may exist in a considerable quantity in a water, without changing vegetable blues.

VIII. A SLIGHT impregnation of SULPHUR, thereby darkening the nitrated silver; this is what might reasonably be expected, as within about four miles there is a proper strong scented sulphurous spring.

THE

THE last mentioned experiment, on the waters, previous to ebullition, (see p. 20.) proves, by the precipitate's not appearing granulated, that vitriolic acid does not exist in these waters, either in a simple or combined state.

THE presence of an uncombined alkali, (if we may still be permitted to call aerated alkali's so) as proved, by the boiled water's rendering infusion of lark-spur green, clearly proves the non-existence of any earthy or metallic salts in this water ; since the alkali, from its superior attraction to acids, must entirely prevent their formation.

FROM the above effects of reagents, it appears, that *the waters contain*

Cretaceous acid,

Aerated iron,

Lime, supersaturated with cretaceous acid;

A muriatic neutral salt,

A cretaceous alkali,

and a Sulphurious impregnation.

THE proportion of each of the above ingredients, and the nature of the base of the neutral, and the species of the cretaceous alkali, yet remain unknown ; I therefore proceeded, by the more tedious processes of distillation, evaporation, and chrystalization, to ascertain these points.

IV. DIS-

IV. DISTILLATION.

FROM the experiments of Bergman, it appears that water is capable of absorbing about equal its bulk of cretaceous acid, at the temperature of 55° , and proportionably less as its temperature is increased. Now, as before observed, the bubbles of this acid, are continually passing through the waters, under examination, it is therefore clear that they must be fully saturated with it, and as their temperature is higher than that at which water will retain its equal bulk, we are obliged to conclude, that it does not contain quite so much; but from the following experiment I doubt whether it lacks much of it.

By the means of a florence flask, with a syphon properly affixed to it and the application of heat, I collected, from a given quantity of this water, in a glass vessel that had been previously filled with, and inverted in hot water, upwards of its bulk of aerial fluid, the greater part of which I take to be the abovementioned acid; the rest, perhaps, partly atmospheric mephites, and partly vital air. That the water contains this last, is proved, by its depositing an ochery substance, after having some green vitriol dissolved in it, in a well corked viol.

D

V. EVA-

V. EVAPORATION.

AFTER evaporating ten pounds of the water of the rock, in glass vessels, by the heat of a *water bath*, I obtained a brownish coloured residue, which when dried, weighed 6 drachms, 2 scruples, 3 grains; this residuum was put into four times its weight of *spirits of wine*, and after standing a considerable time, being frequently agitated; was filtered and dried, and was found to have lost about 17 grs. which proved to be common salt; for by evaporating the spirits, I obtained it in regular *cubic chrystals*. This circumstance of spirits of wine dissolving a portion of marine salt, I take to be owing to its not being so highly rectified, as it ought to be: for when perfectly pure, it will only take up salited lime, and salited magnesia, nitrated lime, and nitrated magnesia, and salited terra ponderosa; but when somewhat diluted, it will, beside these salts, also take up others: but, however, as by evaporation I obtained nothing but cubic chrystals, I now conclude, positively, what in fact was before proved by reagents, that there are none of the above mentioned earthy salts in these waters.

I now immersed the residuum in 8 oz. of *cold distilled water*, which, after remaining several hours, and being frequently agitated, was filtered; the insoluble residue being dried and weighed,

ed, was found to have lost, 3 drachms, 2 grains; this watery solution, by turning the infusion of larkspur green, is proved to contain an uncombined alkali. Experiments before made, shew that these waters contain the muriatic acid, and as the mutual attraction, between an acid and an alkali, will not permit them to remain in company with each other, particularly when surrounded by their conjunctive agent, water: without uniting, therefore, we must again suppose this acid to be in combination, and indeed its not rendering the infusion of larkspur red, decidedly forbids any other conclusion.

THIS solution of a muriatic neutral salt and an alkali, I submitted to the heat of the sun, whereby, after great part of the water was evaporated, some *cubical chryſtals* appeared to form upon its surface, but which were soon disturbed, by *irregular saline concretions*.

HAVING ascertained the presence of a *muriatic neutral salt*, and an uncombined *alkali*; but not knowing decidedly, either the species of the alkali, or the base of the neutral salt; I therefore made a saturated solution of this mixed salt, and added thereto, *acid of tartar*, and no precipitation taking place, I concluded that no *vegetable alkali* can be present, or it would have fallen down in the form of *cremor tartar*; therefore, the *aerated alkali* must be of the *mineral kind*, and

and the base of the *neutral*, must be the same, which, with its acid, forms our common *sea salt*.

To find the *proportion* of the marine salt and the alkali, I dissolved the mixed salt in water and added *distilled vinegar* thereto, until I brought it to the exact point of saturation: I then saturated an equal quantity of distilled vinegar, with mineral alkali, for which purpose it required 26 grains, whence it appears, that ten pounds of this mineral water contains 26 grs. of *mineral alkali*, the remainder, 156 grs. must be common *salt*, which added to the 17 grs. dissolved in the spirits of wine, makes ten pounds of the water contain 173 grs.

THE remaining 3 drachms, 1 scruple, 4 grains, I exposed to the sun, for several weeks, moistening it frequently with rain water; this was done, in order to rust the iron, so as to make it insoluble in *distilled vinegar*; in which this residue was afterwards digested and filtered. The filtered liquor was then evaporated, and what was left, was re-dissolved, in *vitriolic acid*, with which it formed a *gypsum*, but no bitter salt; hence, as there was but about 12 or 14 grs. remaining on the fillet, it appears that ten pounds of this water contains 3 drachms, 10 grs. of *aerated lime*—but no *magnesia*.

THE substance remaining on the filter, by being dissolved in *vitriolic acid*, afforded 8 and 1-2 grs.

grs. of iron, precipitated in form of Prusian blue, by the Prusian lime-water.

It appears, from a review of these experiments that a quart of this water must contain,

Cretaceous acid,	about 40 cubic inches,
Mineral alkali,	5.2 grs.
Common marine salt,	34.6
Aerated lime,	38.0
Aerated iron.	1.7.



BARKER's SPRINGS.

THE mineral waters that have been already noticed, are not the only one's in the county of Saratoga. About three miles below the junction of Fish-Creek with the North River, and about two miles west of the latter, in a hollow belonging to, and immediately back of the dwelling house of, *William Barker*, are several mineral springs, the waters of which, both by their sensible qualities, and by the operation of reagents, appear to be very similar to those heretofore mentioned. They do not, however, deposit the stony matter, as the others do, nor do they in other respects, appear to be so strongly impregnated with mineral substances.

THEY are situated in a clayey soil, with no appearance of lime-stone in their neighbourhood. The land is covered with beach and oak trees.

THE air which bubbles up in these springs, by the experiments formerly mentioned ; appears to be the same *cretaceous acid* as is discharged from the other springs, it equally *extinguishes flame*, render *lime water turbid*, &c.

THE water is also proved to contain the same air in its composition, not only by the experiments as made at the other springs ; but also by its not being able to support animal life. *A fish* in two and a half minutes *died* in it.

IRON appears to exist in these waters, by their becoming *tinged*, though slightly with *tinctorie of galls* ; and it must be aerated ; since this property no longer continues after the water has been boiled.

LIME rendered soluble by a *superabundance of cretaceous acid* ; was detected in these, by the same means as were used with the other waters.

THEY contain *aerated ALKALI*, therefore after being boiled they still effervesce with *vitriolic acid*.

A MURIATIC ACID is proved to exist in them, by the *nitrated silver*, and *nitrated mercury* ; and it must be in combination ; thereby forming a *neutral salt*, whose base, though not fully ascertained, is presumed from its taste, and the great similarity there is between these and the other wa-

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ters, to be of the mineral kind; therefore the neutral I believe to be *sea salt*.

BESIDES these acefcent springs there is also another in the same hollow; about a stones throw distance from them, which is entirely of a different nature, and from its smelling like the washings of a gun-barrel, has gained the name of the *gunpowder spring*. The water is *transparent*: its *temperature* 58° ; it *smells* and *tastes* like sulphur, or rather liver of sulphur; by boiling it looses both its disagreeable smell and taste.

THE *air* discharged from it by boiling, being made to pass through *lime water*; produced *no turbidness*, hence they contain no free *ætrial acid*.

THIS water is not discoloured either by *tincture of galls* or *Prussian lime water*.

WITH *nitrated mercury* it forms a *precipitate*.

WITH *nitrated silver* it also forms a precipitate; which as well as the water directly assumes a *dark purpleish brown* colour: this precipitate is suspected to arise from a *marine acid*, and the dark colour from *hepatic or sulphurious gas*.

Vitriolic acid, produces an *effervescence*, this must be owing to the presence of a *cretaceous alkali*, it also rendered *lime water turbid*; this must be from the same cause, hence the above-mentioned muriatic acid must be in combination, in form of a *neutral salt*.

OF

OF THE MEDICAL VIRTUES OF THE WATERS OF SARATOGA.

Notwithstanding these waters, when properly applied may be useful in many complaints; yet as is generally the case with medicines that get into practice, and gain a degree of reputation, before their real qualities are known; they are used too indiscriminately for the cure of almost every disease, even those of a directly opposite nature, thus we find intermittents, pleurisies, dropsies, manias, &c. all equally apply here for help, and what is still more extraordinary, while I was at the springs I saw a person there who had come upwards of three hundred miles, to drink the waters for the cure of a fistula lachrymalis.

THESE waters may be taken in very large quantities into the stomach without producing any uneasiness or weight, excepting sometimes in delicate stomachs, they cause a sense of coldness and sometimes proves emetic: some persons will drink several quarts within half an hour, without any inconvenience, in which case they generally operate two or three times by stool, and very copiously by urine; they at the same time frequently produce a gentle diaphoresis; they more particularly act upon these two last excrecories, when taken in small doses as from half a pint to a pint, and repeated four or five times in the course of the

the day ; in some persons these waters induce a degree of inebriety similar to wine : they generally increase the appetite.

It is much to be regretted, that there does not some person properly qualified reside at these springs ; who would keep a register of the complaints of those who apply there for relief ; and the effects of the waters upon them : the want of this obliges us to establish their virtues, from the known effects of the ingredients of their composition, which are now ascertained ; assisted by the inaccurate accounts of the neighbours.

FROM the great relief that Benjamin Colburn first received by the use of an alkaline water, super-saturated with cretaceous acid, and which afterwards proved equally serviceable to his fellow-sufferers, with *stone and gravely complaints* ; and also from the experience of DR. FALCONER in confirming the same*, I have not the least doubt but that these waters may be used with advantage in these complaints ; since they are proved to contain a super-saturated ærated alkali, and also as they are found to operate very quickly and powerfully on the urinary passages ; indeed the neighbours report of its use in such cases, confirms this opinion.

THE cretaceous acid is proved by the experiments of DR. DOBSON, to be a powerful stimulant and antiseptic, and in these waters its being conjoined with a chalybeate ; I fully believe according to the accounts of the neighbours, and persons who
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* See Falconer's appendix to Dobson's commentary on fixed air.

had experienced relief from those complaints, that they may be very serviceable in *chronic rheumatism*, *dyspepsia*, and some other long standing complaints of debility: and also in *old phagedenic ulcers* and *scorbutic complaints*.

FROM their conjoined effects of purgative anti-septic and tonic qualities; they appear to be properly formed for the cure of the *dysentery*: a person at the springs, was using them for this complaint while I was there, he informed me that they formerly cured him of it.

Cutaneous Eruptions, frequently prove very obstinate diseases; therefore are found in great plenty at these springs, and I am happy to add, that they have generally disappeared by the use of the waters: for this purpose they must be used externally, as well as internally. We need not be surprised that these waters are so very useful in such complaints, since from their proving gently diaphoretic, and also by the bathings keeping the skin clean and moist, in conjunction with the sulphurious impregnation, proved to exist in them; they appear to be extremely well calculated for that purpose*.

I HAVE never heard of the effects of these waters in *scrophula*; (or kings evil) but as they contain sea-salt, and as they appear from increasing the different excretions to act particularly on the glandular system; and as they also prove a stimulus

* I am told that during the late war, while the troops lay at Saratoga, many of them were affected with the itch and were sent off in companies to these springs; by which they were all cured.

lus and tonic to the system at large. I think them well deserving a trial in this disease.

THEIR use in *hypochondriasis* and other *nervous affections*, which are diseases generally arising from the indolence and luxury of a city life ; and consequently a considerable distance from the springs, perhaps depend in a great degree upon the amusing scenes, more simple food and constant exercise, which are unavoidably connected with a long journey ; and if any advantage is gained in *consumptions* from their use, I rather suppose it owing to the same circumstances connected therewith ; since fixed air, which seems to be the predominant agent in the operation of these waters, has, by those who have made experiments thereon, generally been found prejudicial in these complaints, in fact the common report is, that these waters are prejudicial in phthisical complaints.

THESE waters have also been in repute for the cure of *Dropsey*, and from their possessing such a conjoined stimulant, and evacuative quality as already mentioned ; it appears very probable that they may promote the absorption of the fluid in the cavities of the human body ; and carry it entirely out of the system.

THERE are likewise very satisfactory accounts of *paralitic* affections, having been cured or at least considerably relieved, by the inward and outward use of these mineral waters.

IT has likewise been related, upon undoubted testimony, that *fevers* and *agues* or *intermittents* have frequently been cured by them.

ALL these observations apply particularly to the asidulous springs. The *sulphur water*, I imagine may be more usefully applied in *cutanious eruptions*, particularly the *itch*; however I believe no trials have yet been made with it in any complaint.

A CONJECTURE UPON THE MANNER OF THE NATURAL FORMATION OF THESE WATERS.

THE manner by which these waters become charged with their iron, lime, salt, and alkali, hardly needs an explanation; as all these substances exist ready formed in the bowels of the earth; and water after being aerated cannot pass over them without taking up a part; but the manner in which it gains this aerial impregnation, as the cretaceous acid does not naturally exist in an uncombined state in the earth; is not so easily accounted for.

THE cretaceous acid is extricated from its combinations in the large way, by three different processes, viz. by *fermentation*, by the action of a *stronger acid*, and by *heat*; the first method cannot operate in this instance, the second may have its effects; let us try how far it will explain the subject in question. Suppose this water first containing a marine acid, should have passed over a quantity of cretaceous alkali; here the acid contained in ten pounds of it, would unite with 73 grs. of pure alkali, which contained, and accordingly will discharge 58 grs. equal 116 square inches of this

this acid. Now the water is supposed to contain at least 200 inches, hence we see that the most favorable statement of this mode, will not account even for the quantity of air actually existing as a component part of the water ; much less for the great superabundance which is continually bubbling up through it, and is discharged. We cannot suppose that the vitriolic acid, might act on calcarious earth, and discharge this air, whereby the water might become impregnated, before it was charged with sea-salt and alkali ; or else we should have detected some glaubers salt in the waters, as they would at the time that they received their air, also unavoidably become saturated with gypsum, which when it came in contact with the alkali would have been decomposed thereby, and form this salt.

WE must therefore conclude, that this air must be produced by *subterranean heat*, acting on calcarious earth or limestone ; thereby setting it at liberty in this great profusion ; indeed the deep caverns opening on the lime stone bank before-mentioned, gives some plausibility to this opinion, for it clearly evinces that some considerable operations must be going forward in the earth below : the only objection that can be raised against this conjecture is, the coldness of the waters, but this may be obviated by considering, that even if they do not come any great distance after their aerial impregnation ; yet they may have afterwards met with their salts, which as is the case with all substances going from the solid to the fluid state, will

will absorb a considerable quantity of heat, during their dissolution, and thereby produce the coldness in question: should any suppose that this cause is not adequate to the production of the coldness of these waters, they are at liberty to consider them as being aerated at a greater distance from the springs than is suggested; my above observations however will not permit them to suspect but that the air they contain must have been evolved from its combination by subterranean fire, the which is proved, by the heat of the waters of Lebanon, to exist at no great distance * from these springs.

By the waters running over a bed of sulphur, their alkali may form a hepar with this mineral; the gas discharged from which, may give them their sulphurious impregnation.

A METHOD OF MAKING AN ARTIFICIAL MINERAL WATER, RESEMBLING IN EVERY RESPECT THAT OF SARATOGA.

ONE great advantage resulting from the Analysis of mineral waters is, the being enabled thereby to make artificial waters similar to them, whence all their virtues may be obtained at pleasure; and at any place, without the inconvenience or expense of attending at the springs.

THERE are some mineral waters, that from the fixed nature of their ingredients, may be kept for a considerable time and transported from place to place without suffering much, if any, alteration in their natures; as for instance those of Epsom, Richmond,

* About 50 miles.

Richmond, Swansey, and the like ; while others as those of Pyrmont, Seltser, Saratoga, &c, notwithstanding our greatest care, can be kept but a short time and consequently cannot be conveyed to any great distance, without loosing in a considerable degree their medicinal qualities ; for besides the cretaceous acid which from its volatile nature flies off, the iron that was kept in solution thereby, is also deposited ; hence they must loose the two most active and essential parts of their composition ; therefore if any one would have these waters at a distance from the springs, it is art alone that can supply him.

THE manner in which I prepared a water resembling the Saratoga waters, not being possessed of Nooth's apparatus, was as follows : To a quart of simple water, I added 38grs. aerated lime or chalk, 34.6 grs. common salt, and 5.2 aerated mineral alkali ; being just the proportion that I obtained from a quart of the mineral water ; I also suspended in it some fresh iron filings tied up in a linen rag, then by means of a bottle with a syphon affixed to it, and which also had a mouth whereby I could put in my ingredients, I caused the air that was discharged from chalk by a diluted vitriolic acid, to pass through the water above-mentioned, till it appeared to be fully saturated : to this water was then added some coarsely powdered sulphur, which after standing awhile was decanted off.

THIS liquor was now acknowledged by several persons

persons who had drank of the Saratoga water, perfectly to resemble them in taste.

Most of the reagents used on the natural waters, were repeated on these and with like effects ; here then is a clear proof of the success of the analysis, for synthesis or the recombination of a substance, with similar ingredients to what were obtained from it, by all chemists is considered the surest evidence of the truth of an analysis.

NOTWITHSTANDING I have not had an opportunity of trying the effects of this water in diseases, yet the above circumstances proving it to be composed of the same ingredients as the natural waters ; leaves no doubt, but that it must possess the same medicinal virtues.

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